COMMITTEE ON SCIENCE
U.S. HOUSE OF REPRESENTATIVES

HEARING CHARTER

Tsunamis: Is the U.S. Prepared?
January 26, 2005
10:00 a.m. to 12:00 p.m.
2318 Rayburn House Office Building

Purpose:

On January 26, 2005, the House Committee on Science will hold a hearing to better understand the causes of tsunamis, the risks they may pose to the U.S. and to the rest of the world, and how the U.S. should prepare for them.

Although tsunamis are infrequent, their force and destructive power have recently become all too clear. On December 26, 2004, a magnitude 9.0 undersea earthquake off the west coast of northern Sumatra, Indonesia, unleashed a tsunami that affected more than 12 countries throughout Southeast Asia and stretched as far as the northeastern African coast. Massive tsunami waves hit the Indonesian coast within minutes of the earthquake, and other deadly waves raced across the entire 3,000-mile span of the Indian Ocean Basin within hours. Current estimates indicate that at least 150,000 people were killed, and millions more were injured, displaced or otherwise affected. Experts believe that the earthquake which caused the tsunami was the most powerful in 40 years and the fourth largest in the last century. The death toll appears to be the worst on record for a tsunami.

While no tsunami has caused equivalent devastation in the U.S., tsunamis have hit the U.S. in recent decades, almost all of them generated in the Pacific Ocean.

To protect the U.S., the National Oceanic and Atmospheric Administration (NOAA) operates two tsunami warning centers, one in Alaska and one in Hawaii. The Hawaiian center dates back to 1948, and the entire current warning system, which includes ocean buoys, has been in place since 2001. In response to this recent disaster, on January 14, 2005, the Administration announced an interagency plan to increase U.S. risk assessment, detection, warning and disaster planning for tsunamis. The plan would cost $37.5 million over two fiscal years.

The Committee plans to explore the following overarching questions at the hearing:

1) Which regions of the U.S. and the rest of the world face the greatest risk from tsunamis?
2) What are the best methods to detect tsunamis and provide effective warnings? What are the best methods to educate the U.S. about the risks of tsunamis and how to be prepared for them? How well does the Administration's new tsunami plan incorporate these methods?
3) What should the U.S. do to help the rest of the world better prepare for tsunamis?

Witnesses:

Dr. Charles "Chip" Groat, Director of the United States Geological Survey.
Gen. David L. Johnson (ret.), Director of the National Ocean and Atmospheric Administration's National Weather Service.
Dr. John Orcutt, Deputy Director for Research at the Scripps Institution of Oceanography, University of California at San Diego, and President of the American Geophysical Union.
Dr. Arthur Lerner-Lam, Director of the Columbia Center for Hazards and Risk Research, Lamont-Doherty Earth Observatory, Columbia University.
Mr. Jay Wilson, Coordinator of Earthquake and Tsunami Programs, Plans and Training Section, Oregon Emergency Management.

Background:

What is a tsunami?
A tsunami is a series of ocean waves that are generated by a violent undersea disturbance or activity, usually an earthquake, but sometimes a volcanic eruption, landslide or even a meteor impact. These events cause tsunamis when they result in the sudden displacement of a large volume of water. Earthquakes displace water by suddenly raising or lowering the sea floor; in the case of the recent earthquake the Earth's crust moved at least an inch and the force was large enough to affect the planet's rotation. Waves from the underwater disruption travel out of the area of origin at speeds above 500 miles per hour for thousands of miles (depending on the depth of the water). The waves are often not visible on the water's surface in the open ocean, but when the waves reach shallower coastal shelves, their speed slows and the waters pile up, gathering enormous force. Usually, it takes an earthquake with a magnitude above 7.5 on the Richter scale to generate a tsunami that causes noticeable damage, and scientists are reluctant to predict that a tsunami has been generated unless an earthquake measures at least 8.0.

Where do tsunamis occur most frequently and why?
Tsunamis can be generated in any of the world's oceans or inland seas, but at least 80 percent of all tsunamis occur in the Pacific Ocean. Tsunamis are concentrated in the Pacific because the geology of the Pacific Rim makes it the area on Earth most susceptible to earthquakes and volcanic eruptions, earning it the nickname "Ring of Fire." The Earth's crust is not a single, fixed entity, but rather is made up of large tectonic plates that slowly move about. Earthquakes and volcanoes most often appear at the points where two or more plates abut each other. The entire Pacific rim is lined with areas in which plates rub up against each other, or where one plate dives back toward the Earth's core, scraping underneath another tectonic plate. The most active areas of the "Ring of Fire" include the coasts off Kamchatka, Japan, the Kuril Islands, Alaska and South America. About six times per century, on average, a tsunami from the "Ring of Fire" region sweeps across the entire Pacific, is reflected from distant shores, and sets the entire ocean in motion for days.

Although infrequent, tsunamis have also occurred in the Atlantic and Indian Oceans, the Mediterranean Sea and even within smaller bodies of water, such as the Sea of Marmara, in Turkey. In the last decade alone, tsunamis that have caused significant damage have occurred in Nicaragua (1992), Indonesia (1992, 1994, 1996), Japan (1993), Philippines (1994), Mexico (1995), Peru (1996, 2001), Papua-New Guinea (1998), Turkey (1999), and Vanuatu (1999).

Brief history of recent tsunamis that have hit the U.S.

In 1918, an earthquake in the Caribbean generated a wave that caused the deaths of 40 people in the Virgin Islands.

In 1946, an earthquake along the Aleutian fault (Alaska) produced waves up to 55 feet high, destroying the Hilo's waterfront (Big Island, Hawaii). The tsunami killed 159 people and caused $255 million (in today's dollars) in damage. In response to this event the Federal government established the Pacific Tsunami Warning Center in Hawaii in 1948.

In 1957, an Alaskan earthquake produced a Pacific-wide tsunami causing waves of 75 feet on the Alaska's Umnak Island and waves of 50 feet on Hawaii's Kauai Island. No deaths occurred but damage was estimated at $34 million (in today's dollars).

In 1958, an earthquake triggered a landslide in Lituya Bay, Alaska, creating a tsunami with the highest waves in recorded history as trees were stripped to a height of 1,720 feet. However, the tsunami's energy and height diminished rapidly away from the source area and, once in the open ocean, the tsunami was hardly recorded by tide gauge stations.

In 1960, a magnitude 9.5 earthquake, the most powerful earthquake in the 20th century, occurred off the coast of Chile. The resulting Pacific-wide tsunami reached Hawaii with waves as high as 35 feet, causing 61 deaths and $155 million (in today's dollars) in damages.

In 1964, a magnitude 9.2 earthquake, the largest earthquake in the Northern Hemisphere in the 20th century, occurred in Alaska. The resulting tsunami devastated five of Alaska's seven largest communities and nearly destroyed the Alaskan fishing industry. Waves also reached the entire California coastline with heights of seven to 21 feet. Half of the waterfront district in Crescent City, CA was destroyed. The tsunami killed more than 120 people in the U.S. and Canada and caused a total of $515 million in damage (in today's dollars).

How does the U.S. Tsunami Warning System work?

The U.S. Tsunami Warning System is operated by the National Weather Service, which is an agency of NOAA. There are two Pacific Warning Centers: an Alaskan center responsible for Alaska and the West Coast of the U.S., and a Hawaiian center responsible for Hawaii and for acting as the national/international warning center for tsunamis that pose a Pacific-wide threat. The Centers are part of an international Pacific Tsunami Warning System, in which 26 nations participate.

The NOAA Centers are tasked with detecting, locating, and determining the magnitude of earthquakes occurring in the Pacific Basin that could cause a tsunami. Earthquake information is provided by seismic stations operated by NOAA, the U.S. Geological Survey (USGS), universities and other nations. NOAA also operates a series of six Deep-ocean Assessment and Reporting of Tsunamis (DART) buoys and hundreds of coastal sea-level gauges in the Pacific Ocean. Since not all earthquakes cause tsunamis, the DART buoys are critical in verifying that a tsunami has been generated. Before the DART buoys were deployed in 2001, more than half of all tsunami warnings turned out to be false alarms in that either no tsunami occurred at all or the one that was generated was not significant enough to cause any damage. False alarms generate their own costs.

For example, in 1986, an evacuation of Honolulu that turned out to be a false alarm cost the state of Hawaii nearly $40 million.

Once a Center has determined that a tsunami has been generated, the Center issues a tsunami warning that includes predicted arrival times for the waves at specific coastal communities. These warnings are submitted to Federal, state and local emergency management officials, and the nations that take part in the Pacific Tsunami Warning System, which are responsible for relaying the information to the public.

In 1996, NOAA (along with the USGS, the Federal Emergency and Management Agency, and the states of Alaska, Washington, Oregon, California and Hawaii) created the National Tsunami Hazard Mitigation program. The program is designed to help communities prepare for tsunamis by giving them information on how to respond to warnings, helping them determine exactly what is most at risk from tsunamis in their communities, and developing strategies to mitigate the damage that would occur from a tsunami. For example, the program funds mapping of coastal communities to predict which areas of the community are most at risk from the tsunami. These maps are critical for proper evacuation and community preparedness. Public education is also a crucial element of the program because tsunamis can come ashore within minutes of nearby earthquakes. In those instances, people must know what to do immediately in the event of a "felt" earthquake in a low lying coastal area.

The total budget for NOAA's tsunami programs has risen from about $6.6 million in Fiscal Year (FY) 2002 to $10.3 million in FY 2005.

What are Tsunami-Ready communities?

The National Weather Service has developed a program to qualify communities as being "Tsunami-Ready." Communities must meet certain criteria such as having established warning and emergency operations center staffed around the clock, having more than one way to receive tsunami warnings and to alert the public, and having developed a formal tsunami plan that includes emergency evacuation exercises. So far, only 15 communities have qualified as Tsunami-Ready. Some communities have complained that the program requirements are too rigorous and they do not have the time or funding to fulfill them.

Why was the U.S. Pacific Tsunami Warning Center unable to warn the people of the Indian Ocean Basin about the tsunami on December 26, 2004?

While officials at the U.S. Pacific Tsunami Warning Center immediately received seismic information about the massive earthquake off the coast of Indonesia, they were unable to determine if a tsunami had been generated because there are no DART buoys in the Indian Ocean. In addition, the Center initially thought the earthquake was of a lesser magnitude. However, within 15 minutes, the Center issued a bulletin to the 26 nations of the Pacific Region stating that there was minimal risk to the Pacific Ocean Basin counties. NOAA officials did not know of the actual existence of the tsunami until two and a half hours later when news reports began appearing from Sri Lanka. Also, unlike in the Pacific, no international warning system has been put together to disseminate information about events in the Indian Ocean Basin. However, NOAA officials did contact the State Department to see if it could distribute information. Unfortunately, the State Department was not called until seven hours after the earthquake, but that still may have been enough time to warn communities on the East coast of Africa.

Recent Developments:
On January 14, 2005, the Administration announced a new $37.5 million plan to improve tsunami detection, warning, and community preparedness for the U.S. Under the plan, NOAA would receive $14.5 million in an Emergency Supplemental Appropriation in the current fiscal year and $9.5 million in the proposed FY 2006 budget, which is due to be released February 7, 2005. The money would be used to purchase and deploy 32 DART buoys and 38 new tide gauges around the U.S. and its territories. That equipment would provide additional coverage in the Pacific and initiate coverage in the Atlantic Ocean and the Caribbean. NOAA would also expand its education and outreach efforts, develop tsunami inundation maps for more coastal communities, and enhance tsunami warning distribution through new hardware and software. The USGS would receive $8.1 million in the Emergency Supplemental Appropriation and $5.4 million in the FY 2006 budget to improve seismic monitoring and information delivery from the Global Seismic Network. More information about the plan can be found at www.noaanews.noaa.gov .

On January 18, 2005, the United Nations hosted a conference on natural disasters in Kobe, Japan to coincide with the 10th anniversary of the earthquake that ravaged that city. While the discussion was to be about preventing natural disasters in general, the issues surrounding the Indian Ocean earthquake and tsunami dominated the conference. Many nations called for the immediate creation of an Indian Ocean tsunami warning system, but it was unclear what specific actions would be taken.

Much of the discussion was about how to better educate the public about tsunamis. While the technology exists to cover the Indian Ocean and the world with buoys and sensors, experts warn that many of the areas hit by the recent tsunami suffer from deep poverty and lack basic education and communication networks, making it difficult to deliver warnings and promote the proper response. Delegates from Japan, which has the most sophisticated tsunami warning system, said they still have great difficulty in educating the Japanese public about the destructive nature of tsunamis and what to do if they feel an earthquake near the shore.

The Administration has said that its new tsunami warning plan for the U.S. should be part of a global earth observing system and is working with 54 other countries on what that system should entail.

Issues:

1) The Administration's new improved tsunami warning plan proposes $15 million in new activities for NOAA and USGS in FY 06. Given the current fiscal constraints on all Federal agencies, the Committee wants to better understand what programs or functions of NOAA and USGS may have to be reduced or eliminated to pay for these new activities.

2) NOAA has six special tsunami detection (DART) buoys deployed in the Pacific Ocean. However, only three of the six DART buoys are currently operational. The Administration's proposal is for NOAA to operate a total of 38 buoys in the Pacific, Atlantic and Caribbean by mid-2007. Why is 50 percent of the current system not functioning and what is NOAA doing about it? What will be the greatest challenges in operating 38 buoys and how will NOAA overcome these challenges?

3) Most of the proposed $37.5 million in the Administration's tsunami warning proposal is for new buoys and seismic equipment. While new technology and detection systems are important, many experts believe that local education and planning may be at least as important and more difficult to execute. What specific activities does the Administration propose to increase local education and planning and is the current proposal too heavily weighed toward technology?

4) Natural disasters occurring along the world's coastlines are causing significantly more damage and deaths. This is caused by the tremendous growth in population and developmental of coastal areas and not by an increased number or intensity of disasters. Should we spend some of our limited resources on reevaluating our land-use policies?

Witness Questions:

In their letters of invitation, the witnesses were asked to address the following questions in their testimony:

Dr. Charles "Chip" Groat, Director of the United States Geological Survey.
Which regions of the U.S. are tsunamis most likely to affect? What are the possible causes of tsunamis forming in the Atlantic or Caribbean basins and what are the likelihoods that they could form there?

What comprises the U.S. seismic network and how does it operate? What role does the seismic network play in the operations of NOAA's Tsunami Warning Centers? What are the greatest challenges and needs in improving our seismic network?

Please describe in detail how USGS would use the $13.5 million proposed in the President's new tsunami warning plan.

What should the U.S. do to help better prepare the world for tsunamis?

Gen. David L. Johnson (ret.), Director of the National Ocean and Atmospheric Administration's National Weather Service.
Please briefly describe what constitutes the NOAA Tsunami Warning System and the Tsunami Hazard Mitigation Program.

Please provide a step by step account of what happens when a tsunami is suspected by a warning center. What steps were you unable to take after you detected the earthquake on December 26, 2004?

What are the greatest challenges to NOAA in improving the U.S. tsunami warning and hazard mitigation systems?

Please describe how the Administration developed its new tsunami warning proposal and what will NOAA do specifically with the $24 million proposed in the President's new tsunami warning plan.

What role should the U.S. play in helping the world better prepare for tsunamis?

Please include in your written testimony: a status report of the current Deep-ocean Assessment and Reporting of Tsunamis (DART) program; funding levels for all five

NOAA tsunami programs from FY 2003-2005; and specific programmatic details of the Administration's new tsunami warning plan including funding levels for the FY 05 supplemental request, and the FY 06 and FY 07 President's Budget request.

Dr. John Orcutt, Deputy Director for Research at the Scripps Institution of Oceanography, University of California at San Diego, and President of the American Geophysical Union.
What is Scripps' role in the world-wide seismic network? When did Scripps know about the earthquake on December 26, 2004 and what was your response?

What are the all of the elements of an adequate tsunami warning system? Does the U.S. warning system currently contain all the elements?

What are the greatest challenges to improving the U.S.'s tsunami detection and warning systems? What is your opinion of the Administration's new proposal to improve the U.S. tsunami warning system? Are there other activities or actions that the plan should have included? If so, what are they?

How would you recommend that an Indian Ocean and world-wide tsunami warning network could be established? What role should the U.S. play in its development?

Dr. Arthur Lerner-Lam, Director of the Columbia Center for Hazards and Risk Research, Lamont-Doherty Earth Observatory, Columbia University.
What are the major causes of tsunamis and why are they so difficult to predict?

Please provide a brief history of the major tsunamis of this past century. What is the largest tsunami ever recorded? What are the possible causes of tsunamis forming in the Atlantic or Caribbean basins and what are the likelihoods that they could form there?

How should the U.S. weigh the risk of tsunamis against the risk of other natural disasters? What is the best use of our limited resources?

What are the greatest challenges to improving the U.S's. tsunami detection and warning systems? What is your opinion of the Administration's new proposal to improve the U.S. tsunami warning system? Are there other activities or actions that the plan should have included? If so, what are they?

How would you recommend establishing an Indian Ocean and world-wide tsunami warning network? What role should the U.S. play in its development?

Mr. Jay Wilson, Coordinator of Earthquake and Tsunami Programs, Plans and Training Section, Oregon Emergency Management.
Please explain your job in Oregon's Earthquake and Tsunami Planning and Training Office. What are the greatest challenges you face in helping the State and localities prepare for earthquakes and tsunamis?

What is your opinion of NOAA's Tsunami Hazard Mitigation program and NOAA's Tsunami Ready program? Why are there so few communities that participate in the Tsunami Ready program and what can be done to increase participation?

What roles do NOAA, USGS, FEMA play in your activities? How can these agencies be more useful in your efforts?

Please describe inundation maps and how important are they to your ability to plan? Who prepares these maps and who pays for them?

What is your opinion of the Administration's new proposal to improve the U.S.'s tsunami detection and warning programs? Are there ways it can be improved, and if so, what are they?